

Inventor: MACKLIN ET AL  
Serial No.: 10/069,011  
Filing Date: 03/14/2002  
Examiner: MERCADO  
Group Art Unit: 1743

### REMARKS

The Office action of June 29, 2005 has been carefully considered and the application has been amended accordingly.

Claims 1-6 are present in the application.

Claims 1-6 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Miyabashi et al. in view of Ikeda et al. The Examiner has indicated that "a fair reading of applicant's specification appears to be drawn to the metal or metalloid being contained within a hollow portion of the nanotubes. However, ... the claims are not considered commensurate with this embodiment." It is somewhat unclear as whether this is a separate ground of objection, rather than one based upon the prior art.

Applicants have amended parent claim 1 in a further effort to particularly point out what applicants believe to be their invention. It is to be noted that claim 1 has always contained the recitation (in line 3) wherein the invention is "characterized in that the nanotubes contain within them a metal or metalloid ...." Applicants submit that, by definition, a tube, or nanotube, is a hollow structure (as compared to a cylinder that is a solid body) and, to say that the nanotubes "contain within them a metal or metalloid..." was believed to properly define the invention over the cited prior art.

In an effort to be even more precise, parent claim 1 has been

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amended to include the additional recitation, "wherein the metal or metalloid is inside the nanotubes", i.e., not "in the walls" or "on the walls", nor "in the material making up the nanotubes" but, rather, "inside the nanotubes." This limitation is supported in the specification at page 4, lines 3 and 4.

As amended, the claims state (even more) clearly that the claims are directed to anodes of carbon nanotubes where the metal or metalloid is within, or inside the nanotubes. This makes it clear that there is a difference between the anodes of the present invention and the anodes disclosed in the prior art.

A review of Applicants' previous remarks with respect to the Miyabashi and Ikeda patents appears to be appropriate and are set forth below for the Examiner's convenience.

US 4,945,014 (Miyabashi) discloses a lithium cell where the anode comprises lithium and a carrier which is a carbonaceous material and a metal which can form an alloy with lithium. The carbonaceous material is described as being in the form of particles which are preferably 5 to 100µm in size. The particles are described as porous but there is no indication of why the particles are porous or whether the pores perform a purpose.

Miyabashi describes in column 7 several methods of forming the carrier for the anode of the cell. These typically involve mixing metal powder with the carbonaceous particles and molding or heating the powders. There is no indication that the metal enters

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the pores of the carbonaceous particles. Indeed, in method 7 (column 7 line 67 and example 7) the metal is explicitly coated onto the surface of the carbonaceous particles and forms a layer 0.1 to 30 $\mu$ m thick. This method renders any pores in the carbonaceous particles irrelevant. Thus, there is no appreciation of the use of pores in the carbonaceous particles for any particular purpose in Miyabashi.

US 5,879,836 (Ikeda) discloses a lithium battery where the anode is formed from a carbon fibril material. The patent describes the fibrils as being intercalated with lithium. There is no suggestion that the lithium enters the fibril tubes. Ikeda also mentions that the fibrils may be mixed with lithium intercalates (column 4 line 50) and this further suggests that lithium intercalates between the fibrils rather than inside them. Further, Ikeda discloses that the fibrils have 'hemispherical septa spanning the hollow interior' at intervals along their length (column 2 line 34). Applicants submit this means that the fibrils are blocked at regular intervals. Thus if one attempted to fill the fibrils with another material such as a metal the fibril would probably be destroyed.

If one skilled in the art were to try to improve the cells of Miyabashi they would be faced with a huge array of prior art. In the event that one skilled in the art were to choose to follow the teaching in Ikeda then they could choose to use carbon fibrils in

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the cell disclosed by Miyabashi. However, this would not lead to the present invention as the methods given in Miyabashi would not result in metals such as aluminium and tin being inserted into the carbon fibrils. As disclosed in the present invention, metals and metalloids may be inserted into the carbon nanotubes by growing the tube in the presence of the metal or metalloid. In contrast some of the methods for forming the anode disclosed in Miyabashi, such as pyrolysis of the carbon material with organometallics, would be likely to destroy a carbon fibril. Thus, even if one skilled in the art were to try to use a carbon fibril in a lithium ion cell of the type described in Miyabashi, this would not result in the present invention.

Applicants respectfully submit that the present invention has the particular advantage that when lithium alloys with the metal or metalloid within or inside the carbon nanotube there is no change in volume of the anode. This leads to a cell with improved reversibility and improved capacity and therefore the present invention possesses a patentable advance with respect to the disclosures of Miyabashi and Ikeda.

Applicants further submit that the clarifying amendment to parent claim 1 should be entered at this time as placing the application in condition for allowance. As amended, the claims are commensurate with the remarks previously submitted to distinguish over the cited art.

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In view of the foregoing amendments and remarks,  
reconsideration of the application is requested and allowance of  
claims 1-6 is courteously solicited.

Respectfully submitted,

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Date



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